RADON MONITORING PLAN FOR PIT 4

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Introduction

The purpose of this plan is to provide information on how sampling of Waste Pit 4 will be conducted at the Fernald Environmental Management Project (FEMP). This plan is being developed in accordance with a DOE letter (DOE-834-92) submitted to the US EPA that indicated that the DOE would prepare a plan for US EPA review for conducting radon measurements at selected points from the Pit 4 solid surface and vent pipe.

Measurements are to be conducted on Waste Pit 4 to provide an estimate of the average radon-flux emissions from the pit. The sampling and analysis methodology of Standard Method 115 (40 CFR 61, Appendix B) for measuring emissions from the vent pipe and waste pit surface will be adopted in part. For measuring emissions from the vent pipe, methodology similar to Part 1 Radon-222 Emissions from Underground Uranium Mine Vents is proposed. For measuring emissions from the Waste Pit 4 solid surface, Part 2 Radon-222 Emissions from Uranium Mill Tailings Piles is proposed with the exception of using a reduced sample size.

This sampling plan is an addendum to the FEMP Sample and Analysis Plan for Fernald Radon-Flux Measurement Survey, Phase I and the Site-Specific Health and Safety Plan for Fernald Radon-Flux Measurement Survey, Phase I plans that were developed for the initial pit monitoring effort that took place on waste pits 1, 2, and 3 during November 1991. Administrative controls and requirements that were in place to assure the safe undertaking of that task will also be employed in this sampling activity.

Waste Pit 4 Solid Surface

The methodology employs Large Area Activated Charcoal Collectors (LAACCs) to adsorb radon emanating from the surface of the waste pit. The charcoal is analyzed using gamma spectroscopy, following the exposure to determine the amount of radon adsorbed, from which the radon flux density is calculated. Based on past empirical data, it is anticipated that atmospheric radon levels will not be above ambient outdoor background levels during the exposure periods, and therefore no correction factor for LAACC measurements will be necessary.

Waste Pit 4 is to be measured over a 24 hour period using standard LAACCs. A LAACC equivalent to that prescribed in Method 115 will be used to collect the radon-on-charcoal samples for the Standard LAACC measurements. Figure 1 shows a sketch of the collector used. The procedures used to collect the radon-on-charcoal samples and gamma-ray spectral analyses are the procedures that were approved and used by Geo-Tech, Inc. in the 1991 study (Appendix A, Ref. 1). These procedures or their equivalent as appropriate include:

Calibration of Computer Automated Gamma Counting System for Radon Flux Measurements, (RN-FLUX-C), Rev. 0

Measuring Radon Concentrations with Diffusion Barrier Charcoal Canisters, (RN-DBCC-U), Rev. 0

Radon Flux Measurements Using the Large Area Activated Charcoal Collector Method, (RN-FLUX-U), Rev. 0

As described in the procedure RN-FLUX-U, gamma analysis of a "Field Blank" is used to determine the appropriate background count rate for the LAACC sample analysis. Separate "Field Blanks" are to be prepared for the LAACC samples. The charcoal for the "Field Blank" will be taken from the unexposed charcoal and canned at the same time that the LAACCs are being loaded for the measurement.

Twenty to thirty (20-30) samples will be randomly selected from the 100 locations that will be gridded on the Pit 4 site. This is the primary deviation from the sampling methodology contained in Standard Method 115, Appendix B. The reduced number of samples is justified based on the results of empirical data from the radon-flux measurements of Pits 1, 2, and 3 previously conducted at the FEMP and data from a similar waste pile at the Middlesex, New Jersey Sampling Plant (sent to US EPA on June 25, 1992) that had similar concentrations of ^{226}Ra. This proposed sample size is considered to be statistically valid.

Environmental meteorological requirements contained in section 2.1.4 of Method 115 shall also be adhered to. To form a seal around the charcoal canisters on the hypalon cover a larger concentric ring about 1-2 inches high will be placed around the canister and filled with sand. The retainer ring will keep the sand in place and form a seal around the canister without harming the cover.

Waste Pit 4 Vent Pipe

DOE concurs with U.S. EPA's suggestion that direct measurements be made and from the vent pipe to confirm that the flux from the total pit area is less than 20 pCi/m^2-sec.

Limited sampling activity was initiated in March, 1992 to gather preliminary information regarding the radon emanating from the Pit 4 vent and well casings. Although the data was rather limited, the information obtained indicated that the radon concentrations in the well casings were extremely low (one day's sampling of average concentrations was observed to be less than background). Vent pipe measurements were also low (on the magnitude of 1-2 pCi/L [gross concentration]).

Radon emissions from the Waste Pit 4 vent and well casings were measured using calibrated Pylon AB-5 radon monitors which collected an air sample using the pump operation mode. Sampling was conducted from March 23, 1992 through March 28, 1992. With no electricity in the work area, the Pylon units operated on battery power. Since operational times were limited (because batteries were used), three days of data were collected during a five day sampling period. During the second and fourth days of the sampling period the units were recharged.

Two available calibrated Pylon units were used to perform radon measurements.

The vent and one of the three well casings were monitored during each of the three sampling events. The Pylon units drew air from the vent and piezometer well casing area at a flow of 1.0 liter/minute. Data was recorded hourly.

Principle of Operation for Pylon AB-5 Monitors

Scintillation cells, such as the Pylon Model 110A and 300A cells are airtight metal cylinders which have a transparent window at one end and an air intake at the other end. The AB-5's built-in pump can be used to draw air into the 110A or 300A cells. Once inside the cell, radon gas decays into its daughter products. Some of these daughters are alpha particle emitters.

Like all scintillation cells, the 110A and the 300A cells have an alpha sensitive scintillator lining the interior of the cell. This scintillator, which is silver activated zinc sulfide, produces light pulses when it is struck by alpha particles. When an alpha particle strikes the activated sulfide, it becomes a helium atom and the sulfide de-excites by emitting photons (or light pulses). The window in the cell enables equipment such as the AB-5 to count the light pulses.

The AB-5 allows the window in the 110A or 300A cell to be mounted against the end of the photomultiplier tube (PMT) of the AB-5. The PMT amplifies the light pulses and a counter in the AB-5 quantifies them. The AB-5 displays the counts on an eight-digit LCD screen and can print the counts on a printer or transmit them to a computer.

In order to measure radon gas, the measuring system's response to the gas must be known. There is a direct relationship between the number of light pulses counted by the AB-5 and the concentration of radon gas in the cell. The relationship between the counts recorded and the activity of the sample is referred to as counting sensitivity for continuous sampling. Sensitivity is normally determined prior to sampling and as part of the calibration process. WEMCO procedure EM-RM-014 addresses the use of Pylon AB-5s for monitoring radon.

For vent sources with continuous steady flow, the methodology contained in 40 CFR 61, Appendix B, Method 115 is appropriate for measuring the radon release rate (Ci/sec). The vent pipe on Pit 4 however, is a passive collector and may have flow in either direction (inward, outward) dependent upon meteorological conditions. To calculate the flux from the vent the following equation will be employed:

$$\text{Flux (pCi/m}^2\text{-sec)} = \text{pCi/L} \quad X \quad 1000\text{L/m}^3 \quad X \quad 1/\text{m}^2 \quad X \quad \text{m}^3\text{/sec}$$

[FLUX = Concentration X Conv. Factor X 1/Pit Area X Vol Flow Rate]

As such the following methodology is proposed to measure radon emission from the Pit 4 vent:

The radon concentration will be recorded using a Pylon AB-5 radon monitor operating in the pump mode at a collection rate of approximately 1 liter per minute (lpm) or in the passive mode as is appropriate depending on air flow measurements. This measurement method is consistent with section 3.1.6 of 40 CFR 61, Appendix B, Method 114. The samples will be automatically collected and recorded on an hourly basis. Per Method 114 part A-6 (paragraph 3.1.6, page 249), a drying desiccant and filter will be placed in-line to treat the sample gas for particulates before recording the radon concentration in the Lucas cell.

The volumetric flow rate from the vent will be measured using a hot wire anemometer or other low volumetric flow measuring instrument. Multiple readings will be averaged over the week-long sampling period to determine an average daily volumetric flow rate.

Portable air velocity meters are highly accurate instruments that can be used for measuring air velocity, static pressure and temperature. Accurate measurements of extremely low velocities with good sensitivity and readability (down to +/- 3 fpm) can be obtained. Typical accuracy and repeatability of the following magnitude can be obtained: +/- 2% accuracy for each full scale range and +/- 0.25% of full scale reproducibility over a wide temperature range of -20^{0}C to 55.^{0}C

Principle of Operation

The air velocity meter probe consists of two integral sensors: a velocity sensor and a temperature sensor. The velocity sensor is a constant-temperature thermal anemometer which measures "standard" velocity (referenced to 25^{0}C and 760mm Hg), or mass flow, by sensing the cooling effect of the moving flowstream as it passes over the heated sensor. The velocity sensor is heated electrically by the control circuitry in the electronics package. The velocity sensor is a rugged and large hot-wire that is relatively resistant to breakage, and insensitive to particulate contamination. The temperature sensor accurately compensates for temperature variations over a wide range.

The probe is used directly to measure air velocity in open spaces, ducts, and supply and return openings. Static pressure measurements can also be obtained through the use of a pressure attachment. The pressure attachment has a small orifice which is used to direct air on the velocity sensor of the probe. The air flow generated by the static pressure to be measured is proportional to the static pressure. Either negative or positive static pressures can be measured.

Total radon emissions for Waste Pit 4 will be the cumulative average for one day's radon emissions from Pit 4 surface and the vent. Approved procedures are under development for the activities described

REFERENCES

1. Fernald Environmental Management Project Sample and Analysis Plan for Fernald Radon-Flux Measurement Survey, Phase I, P-GJPO-500, Grand Junction, CO, Geotech, Inc., October 1991.

2. Fernald Environmental Management Project Site-Specific Health and Safety Plan for Fernald Radon-Flux Measurement Survey, Phase I, G-GJPO-502, Grand Junction, CO, Geotech, Inc., October 1991.

3. Fernald Environmental Management Project Technical Report of Measurement Results for Waste Pits 1, 2, and 3 for Fernald Radon-Flux Measurement Survey, Phase I, RL-F-92-1, Grand Junction, CO, Geotech, Inc., February 1992.

4. 40 CFR 61, Appendix B, Method 114, Environmental Protection Agency (7-1-91 Edition), 1991.

5. 40 CFR 61, Appendix B, Method 115, Environmental Protection Agency (7-1-91 Edition), 1991.

Diagram of a
Large Area Activated Charcoal Collector
(LAACC)

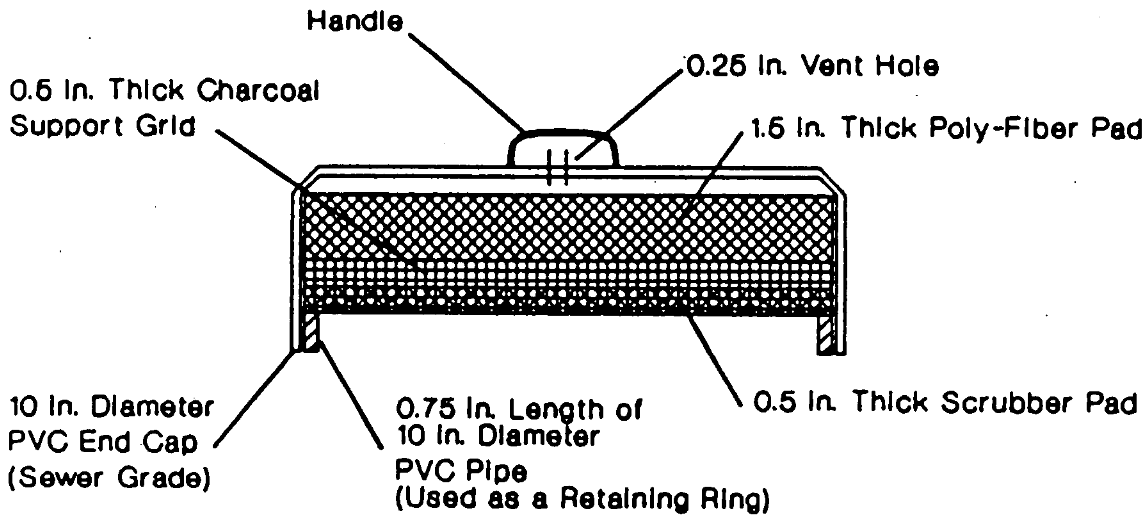

Diagram of a LAACC

FIGURE 1

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